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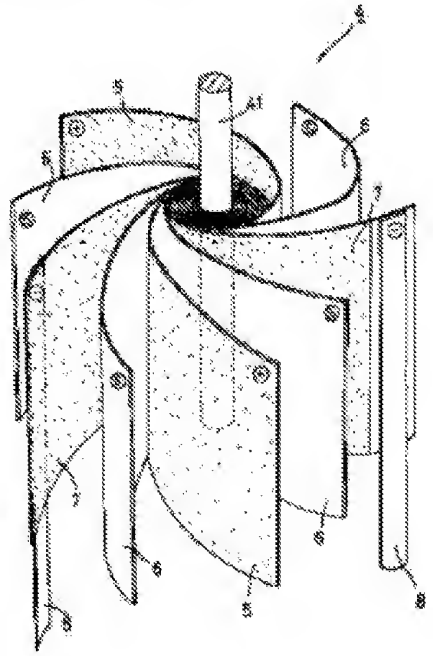
(54) NONAQUEOUS ELECTROLYTE SECONDARY BATTERY

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a highly efficient discharge performance better than the conventional case, regarding a nonaqueous electrolyte secondary battery formed to house a wound electrode body having the charging and discharging capability in a battery can made of a cylinder body and a lid body.

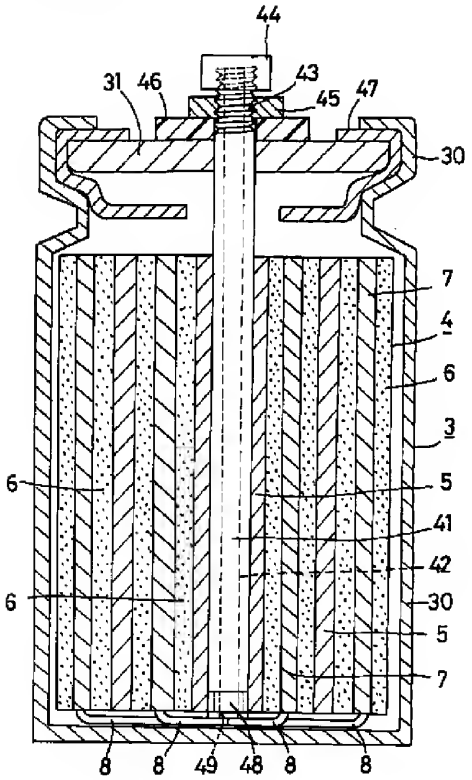
SOLUTION: A wound electrode body 4 has the base ends of two or more strip type positive electrodes 5 connected to a winding core 41, and strip type negative electrodes 7 as counter electrodes are laid among a plurality of the



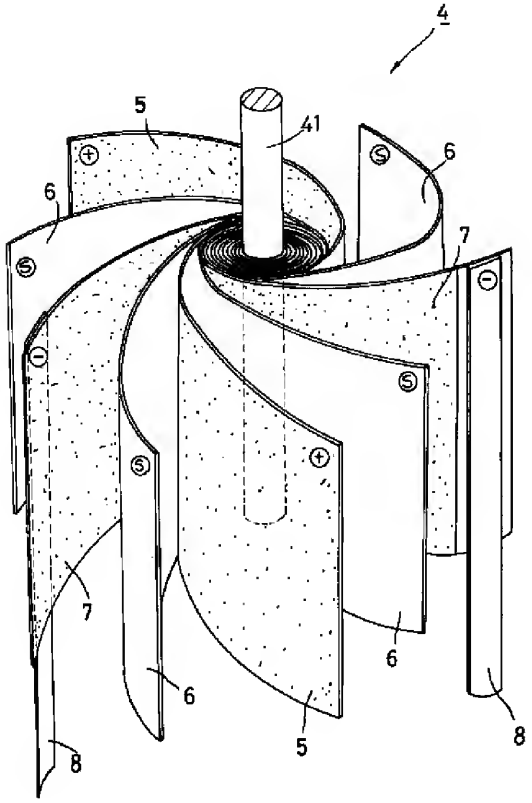
positive electrodes 5. In addition, strip type separators 6 are laid between the positive electrode 5 and the negative electrode 7 faced to each other, and spirally wound. Also, each negative electrode 7 is connected to a cylinder body via a current collecting tab 8, thereby enabling the generated power of the wound electrode body 4 to be taken outside from the upper end of the winding core 41 projected from the cylinder body as well as the cylinder body.

DRAWINGS

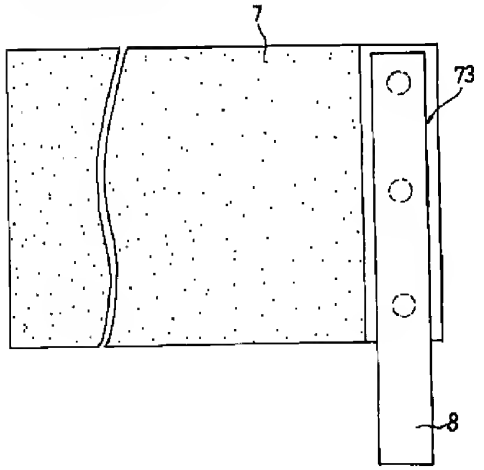
[Drawing 1]



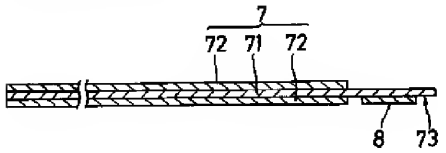
[Drawing 2]



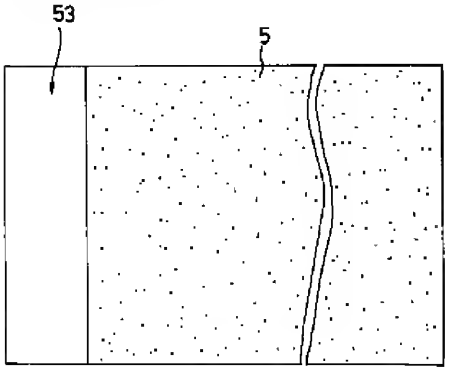
[Drawing 3]



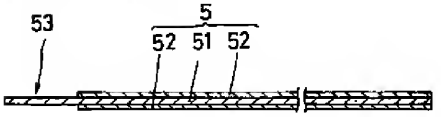
[Drawing 4]



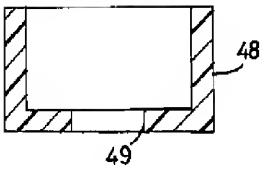
[Drawing 5]



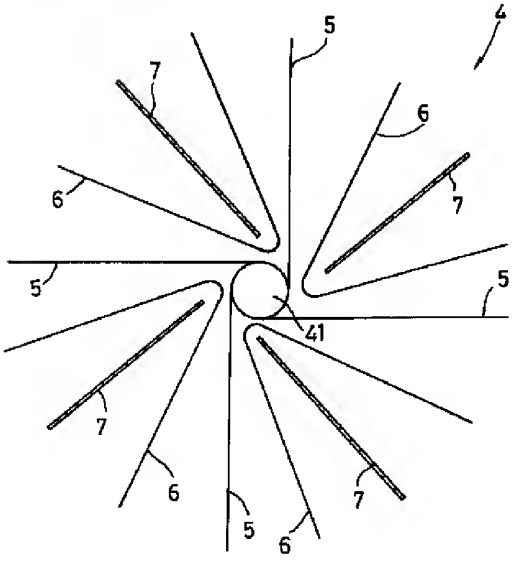
[Drawing 6]



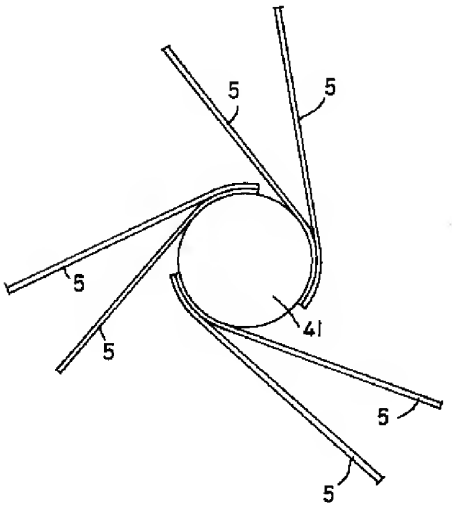
[Drawing 8]



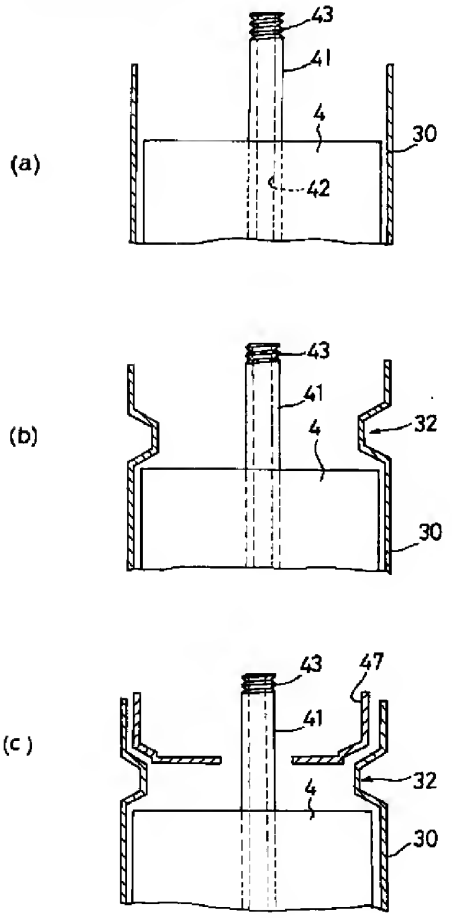
[Drawing 7]



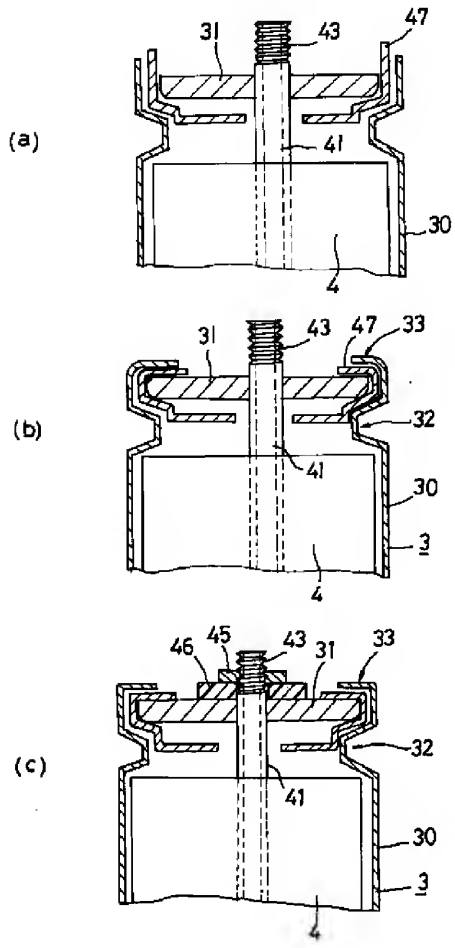
[Drawing 9]



[Drawing 10]



[Drawing 11]


(a)
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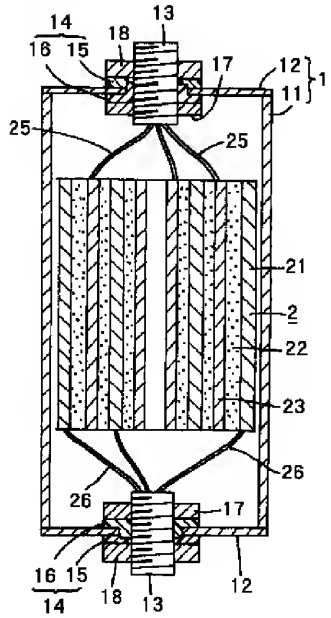
43
47
41
30
4
(b)
31
43
47
33
32
41
30
3
4
(c)
46
45
43
31
33
32
41
30
3
4

[Drawing 12]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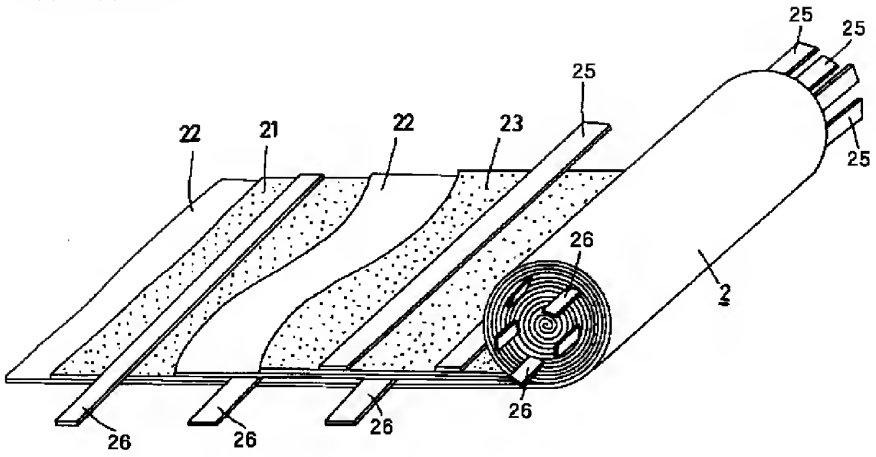
[Drawing 13]



[Translation done.]

CLAIM + DETAILED DESCRIPTION

[Claim(s)]

[Claim 1]Inside a tubed battery can, a rolling-up electrode body in which charge and discharge are possible in a nonaqueous electrolyte secondary battery to accommodate, [a rolling-up electrode body] Put the 2nd band-like electrode that connects a base end of the 1st electrode that presents band-like [of two or more sheets] to a volume core used as the 1st collecting member, and turns into a counter electrode among these 1st electrodes, and. A band-like separator is made to intervene between the 1st electrode and the 2nd electrode which counter mutually, A nonaqueous electrolyte secondary battery which these are rolled round spirally, it is constituted, and each 2nd electrode is connected to the 2nd collecting member, and can take out development electric power of a rolling-up electrode body from said 1st collecting member and the 2nd collecting member to the exterior.

[Claim 2]The nonaqueous electrolyte secondary battery according to claim 1 whose 2nd collecting member is 1 or two or more current collection tabs to which a base end was connected at 1 of a longitudinal direction of the 2nd electrode, or two or more places.

[Claim 3]A battery can fixes a lid to an opening of a cylinder in which an end carried out the opening, and is constituted, one end of a volume core penetrates a lid, and projects it to the exterior, and the 1st electric current extraction terminal area is constituted by this projection part, and. The nonaqueous electrolyte

secondary battery according to claim 2 from which a tip part of said 1 or two or more current collection tabs is connected to a cylinder and which the 2nd electric current extraction terminal area comprises with a cylinder.
[Claim 4]The nonaqueous electrolyte secondary battery according to claim 3 with which an outermost periphery side of a rolling-up electrode body is covered with the 2nd electrode.
[Claim 5]The nonaqueous electrolyte secondary battery according to any one of claims 1 to 4 with which a relation with the width W of a direction where the full length L of a longitudinal direction and a longitudinal direction of the 1st electrode intersect perpendicularly is set as the range of 0.25<W/L<10.
[Claim 6]The nonaqueous electrolyte secondary battery according to any one of claims 1 to 5 whose length of a base end which contacts a peripheral face of a volume core directly and is twisted around it to the full length L of a longitudinal direction of the 1st electrode is not less than 2%.
[Claim 7]The nonaqueous electrolyte secondary battery according to any one of claims 1 to 6 ranges of whose number of sheets of the 1st electrode and the 2nd electrode are three sheets thru/or 30 sheets, respectively.

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the nonaqueous electrolyte secondary battery which accommodates the rolling-up electrode body in which charge and discharge are possible in the inside of a tubed battery can.
[0002]
[Description of the Prior Art]As shown in drawing 12, a nonaqueous electrolyte secondary battery is rolled round inside the battery can (1) which fixes the lid (12) and (12) to the double door oral region of a cylinder (11), accommodates an electrode body (2) and is constituted. For example, in a lithium secondary battery, [a rolling-up electrode body (2)] As shown in drawing 13, [between the positive electrode (21) containing a lithium multiple oxide and the negative

electrode (23) containing a carbon material] The separator (22) with which it was impregnated is made to intervene, nonaqueous electrolyte winds these spirally, and is constituted, and two or more current collection tabs (25) and (26) of the book are pulled out from the positive electrode (21) and the negative electrode (23), respectively.

[0003]Like drawing 12, **** to each lid (12), and the axis (13) has penetrated, and, [between this screw axis (13) and a lid (12)] The insulating member (14) which combines the insulating packing (15) and (16) of two sheets intervenes, and the insulating member (14) is compressed with the nut (17) and (18) of the pair made to screw in a screw axis (13). And the tip part of said two or more current collection tabs (25) and (26) ****s, and welding immobilization is carried out in the end face of the axis (13). In this secondary battery, it can roll round from both the screw axis (13) and (13), and the development electric power of an electrode body (2) can be taken out.

[0004]By the way, high discharge performance is required in the secondary battery especially used as power supplies, such as a portable electronic apparatus and an electromobile. Then, a positive electrode mixture is applied to the surface of the band-like aluminium foil which constitutes a positive electrode except for one side edge part extended to the longitudinal direction, welding immobilization of two or more current collection tabs is carried out in said one side edge part, and the nonaqueous electrolyte secondary battery which constituted the collecting member is proposed (provisional-publication-of-a-patent closed 9-306470[H01M4/02]).

[0005]

[Problem to be solved by the invention]However, in the conventional rolling-up electrode body, high discharge performance is not still enough and the improvement of the further discharge performance is demanded. Then, as a result of this invention persons' doing spirit research, respectively. [the positive electrode of one sheet, and a negative electrode] [the structure of the rolling-up electrode body rolled round spirally] Already think out for an improvement of discharge performance to have a limit, and the rolling-up electrode body which has various structures is thought out, When the performance comparative study

was done about these, it found out demonstrating the discharge performance which was excellent in the rolling-up electrode body which rolled round spirally the positive electrode of two or more sheets, and the negative electrode, respectively, and resulted in completion of this invention.

[0006]

[Means for Solving the Problem]A nonaqueous electrolyte secondary battery concerning this invention accommodates a rolling-up electrode body in which charge and discharge are possible in an inside of a tubed battery can, and, [a rolling-up electrode body] Put the 2nd band-like electrode (negative electrode) that connects a base end of the 1st electrode (positive electrode) that presents band-like [of two or more sheets] to a volume core used as the 1st collecting member, and turns into a counter electrode among these 1st electrodes, and. A band-like separator is made to intervene between the 1st electrode and the 2nd electrode which counter mutually, and these are rolled round spirally and it is constituted. It is possible for each 2nd electrode to be connected to the 2nd collecting member, and to take out development electric power of a rolling-up electrode body from said 1st collecting member and the 2nd collecting member to the exterior.

[0007]In the conventional nonaqueous electrolyte secondary battery, since it had become the structure which rolled round spirally a long positive electrode and a negative electrode of one sheet, respectively, even if two or more current collection tabs were connected and it collected the current, the current collection nature became uneven at an electrode longitudinal direction, and an improvement of high discharge performance had a limit. On the other hand, in a nonaqueous electrolyte secondary battery concerning this invention, since structure which rolled round spirally a positive electrode of two or more sheets and a negative electrode with comparatively short length is adopted, the current collection nature of an electrode becomes uniform, a capacity factor of an electrode becomes high, and high discharge performance improves. Number of sheets of the 1st electrode and the 2nd electrode is checking experimentally that a high effect is especially acquired in three sheets thru/or 30 sheets, respectively.

[0008]The 2nd collecting member is constituted in specific constitution by 1 or two or more current collection tabs to which a base end was connected at 1 of a longitudinal direction of the 2nd electrode (negative electrode), or two or more places. A battery can fixes a lid to an opening of a cylinder in which an end carried out the opening, and is constituted, one end of a volume core penetrates a lid, and projects it to the exterior, and the 1st electric current extraction terminal area is constituted by this projection part, and. A tip part of said 1 or two or more current collection tabs is connected to a cylinder, and the 2nd electric current extraction terminal area is constituted by cylinder. According to this specific constitution, [a charge by which it is generated between the 1st electrode (positive electrode) of two or more sheets, and the 2nd electrode (negative electrode), respectively] The 1st electrode side is efficiently collected by volume core (41), and with two or more current collection tabs, a current can be collected efficiently, and the 2nd electrode side can be rolled round from the 1st and 2nd electric current extraction terminal areas, and can take out development electric power of an electrode body to the exterior.

[0009]In specific constitution, a relation with the width W of a direction where the full length L of a longitudinal direction and a longitudinal direction of the 1st electrode (positive electrode) intersect perpendicularly is set as the range of $0.25<W/L<10$. The length of a base end which contacts a peripheral face of a volume core directly and is twisted around it is set up to not less than 2% to the full length L of a longitudinal direction of the 1st electrode (positive electrode). It is checking experimentally that high discharge characteristics are improved especially in these numerical value ranges.

[0010]In a rolling-up electrode body, if structure where the outermost periphery side is covered with the 2nd electrode (negative electrode) is adopted, it is not necessary to aim at an insulation between a peripheral face of a rolling-up electrode body, and inner skin of a battery can.

[0011]

[Effect of the Invention]According to the nonaqueous electrolyte secondary battery concerning this invention, the current collection nature of an electrode is improved and high discharge performance higher than before is obtained.

[0012]
[Mode for carrying out the invention]Hereafter, this invention is concretely explained over Drawings about the form carried out to the lithium secondary battery. The secondary battery concerning this invention is provided with the metal battery cans (3) which fix a lid (31) to the opening of the cylinder (30) in which the end carried out the opening as shown in drawing 1, accommodates the rolling-up electrode body (4) in which charge and discharge are possible in the inside of this battery can (3), and is constituted. Insulating packing (47) intervenes between the opening of the cylinder (30) of a battery can (3), and a lid (31), and electric insulation and a seal are given.
[0013]The metal volume core (41) is installed in the central part of a rolling-up electrode body (4), the head of this volume core (41) penetrates a lid (31), and projects it to the exterior of a battery can (3), and the screw part (43) is formed in this projection part. Insulating packing (46) is inserted in the head of the volume core (41) projected from a lid (31), and. Bind tight in a screw part (43), a nut (45) screws, a lid (31) is fixed to the opening of a cylinder (30) by bolting of this bolting nut (45), and the insulating packing (47) and (46) was compressed and seal nature is secured. The cap nut (44) is screwing in the screw part (43) of a volume core (41).
[0014]As shown in drawing 2 and drawing 7, a rolling-up electrode body (4) connects the base end of the positive electrode (5) of two or more sheets with the peripheral face of a volume core (41), and puts a negative electrode (7) between it between the positive electrodes (5) of two or more of these sheets, and. [an electrode body] A separator (6) is made to intervene between the positive electrode (5) and negative electrode (7) which counter mutually, and these are rolled round spirally and it is constituted.
[0015]Apply the positive electrode mixture (52) and (52) to both sides of aluminium foil (51), and a positive electrode (5) is constituted, as shown in drawing 5 and drawing 6, The non-coating part (53) to which a positive electrode mixture is not applied is formed in the end part of the longitudinal direction of aluminium foil (51), and this non-coating part (53) is twisted around the peripheral face of said volume core (41). On the other hand, apply the negative electrode

mixture (72) and (72) to both sides of copper foil (71), and a negative electrode (7) is constituted, as shown in drawing 3 and drawing 4, The non-coating part (73) to which a negative electrode mixture is not applied is formed in the end part of the longitudinal direction of copper foil (71), and the current collection tab (8) is connected with this non-coating part (73).

[0016]As shown in drawing 1, where it rolled round in a battery can (3) and an electrode body (4) is accommodated, two or more current collection tabs (8) extended from a negative electrode (7) of this rolling-up electrode body (4) are folded up to the volume core (41) side, and welding immobilization of those tip parts is carried out on the bottom of a cylinder (30). A central hole (42) for making an electrode needle for spot welding insert in a volume core (41), when [said] welding two or more tip parts of a current collection tab (8) of a book to the bottom of a cylinder (30) is established. An insulation cap (48) for winding with two or more current collection tabs (8), and insulating a core (41) electrically has fitted into a lower limit part of a volume core (41). It is possible for a hole (49) to be established as shown in drawing 8, and to make the above-mentioned electrode needle insert in the bottom of this insulation cap (48).

[0017]In manufacture of a secondary battery concerning this invention, drawing 10 (a), (b), (c), and drawing 11 (a), (b), and (c) express a process of obturating a battery can (3). As shown in drawing 10 (a), where [first,] it rolled round in a cylinder (30) and an electrode body (4) is accommodated, An electrode needle for spot welding is intercalated in a hole (49) of an insulation cap (48) from a central hole (42) of a volume core (41) shown in drawing 1, and a tip part of two or more current collection tabs (8) which were able to be gathered up in the central part is welded to the bottom of a cylinder (30) like illustration.

[0018]Then, like drawing 10 (b), spinning is slightly performed to a downward neck portion from the upper limit of a cylinder (30), and a converging section (32) is formed. Next, as shown in the figure (c), insulating closed-end cylinder-like packing (47) is installed on the converging section (32) of a cylinder (30). Then, as shown in drawing 11 (a), after installing a lid (31) on insulating packing (47), as shown in the figure (b), spinning is performed to the upper limit part of a cylinder (30), a converging section (33) is formed, with this converging section

(33), it escapes to a lid (31) and a stop is performed.
[0019]Next, insert disc-like insulating packing (46) in a volume core (41), and also bind tight in a screw part (43), a nut (45) is made to screw, and it binds tight. Finally, a cap nut (44) is thrust into the head of a volume core (41), and a central hole (42) is closed. By this, the nonaqueous electrolyte secondary battery of this invention is completed.
[0020]
[Working example][both sides of the aluminium foil (20 micrometers in thickness) as a production positive electrode current collector of a positive electrode] The positive electrode mixture which consists of positive active material ($LiCoO_2$), a conducting agent (carbon powder), and a binder (fluororesin powder) was applied with the doctor blade method, suction drying of 2 hours was performed at 150 **, and the **** positive electrode shown in drawing 5 and drawing 6 was obtained. The non-coating part (53) was formed in the end of a longitudinal direction like illustration at the positive electrode (5).
[0021]The negative electrode mixture which becomes both sides of copper foil (20 micrometers in thickness) as a production negative electrode current collection object of a negative electrode from a negative electrode material (graphite powder) and a binder (fluororesin powder) was applied with the doctor blade method, suction drying of 2 hours was performed at 150 **, and the **** negative electrode shown in drawing 3 and drawing 4 was obtained. Like illustration, the non-coating part (73) was formed in the end of a longitudinal direction at the negative electrode (7), and the 5-mm-wide current collection tab made from nickel (8) was connected with this non-coating part (73).
[0022]$LiPF_6$ solute was melted in the mixed solvent of preparation ethylene carbonate and diethyl carbonate of an electrolyte, and the electrolyte was prepared.
[0023]The positive electrode of the number of predetermined leaves has been arranged to the circumference of the assembly outside diameter of 6 mm of a cell, and 3 mm in inside diameter the volume core made from an aluminium at equal intervals, the non-coating part of each positive electrode was wound

around it, and welding immobilization was carried out in the peripheral face of the core. When there was much number of sheets of a positive electrode, as shown in drawing 9, the non-coating part of the positive electrode (5) of two or more sheets (a figure two sheets) and (5) was rolled in piles, and welding immobilization was carried out in the peripheral face of the core (41). And as shown in drawing 7, the negative electrode (7) was put between positive electrodes (5), and the separator (6) was made to intervene between the positive electrode (5) and negative electrode (7) which counter mutually, these were spirally rolled round like drawing 2, and the rolling-up electrode body (4) was obtained. As a separator (6), the fine porous membrane made from polypropylene of ionic permeability was adopted. The base end of the volume core (41) was equipped with the insulation cap made from Teflon (48).

[0024]Thus, the obtained rolling-up electrode body (4) was accommodated in the cylinder made from SUS (30) like drawing 10 (a). And said electrolyte was poured into the inside of a cylinder (30) after welding the tip part of the current collection tab (8) extended from a negative electrode (7) like the above-mentioned to the bottom of a cylinder (30). . Then, pass the process of drawing 10 (b), (c), and drawing 11 (a), (b) and (c). The lid made from SUS (31) was fixed to the opening of a cylinder (30), and also insulating packing (46) was inserted in the screw part (43) of the volume core (41) projected from a lid (31), the bolting nut (45) was bound tight, and the secondary battery concerning this invention was produced.

[0025]On the various cells of the measurement after-mentioned of the battery characteristic, the charge-and-discharge experiment was conducted on condition of the following, and the capacity maintenance rate of discharge at the high rate over discharge at a low rate was measured. A discharge capacity maintenance rate is defined by the ratio (percentage) of the high discharge capacity to low rate discharge capacity.

[Low rate discharge]

Charging current: 400-mA and charge final voltage:4.1V, discharging current:400mA, and discharge final voltage:2.7V [high discharge]

Charging current: 400-mA and charge final voltage:4.1V and discharging

current:5A and discharge final voltage:2.7V [0026]** The high discharge characteristics of the conventional cell were compared with the high discharge characteristics of the cell concerning this invention in the experiment 1 experiment 1. The cell A concerning this invention is provided with the positive electrode of ten sheets, and, as for each positive electrode, the length of 150 mm and a non-coating part is formed [width] in 5 mm for 50 mm and full length. On the other hand, the comparison cell X which is the conventional cell is provided with the positive electrode of one sheet, width is 50 mm, full length is 1500 mm, as for this positive electrode, it has a non-coating part 5 mm in length at the end of a longitudinal direction, and one 5-mm-wide current collection tab made from an aluminium is welded to this non-coating part. It has the same structure as this invention cell A except it. The comparison cell Y is provided with the positive electrode of one sheet, this positive electrode has a 5-mm-wide non-coating part in one side edge which width is 50 mm, and full length is 1500 mm, and is extended to a longitudinal direction, and ten 5-mm-wide current collection tabs made from an aluminium are welded to this non-coating part. It has the same structure as this invention cell A except it. The measurement result about these cells A, X, and Y is shown in Table 1.

[0027]

[Table 1]

	正極枚数（枚）	正極幅（mm）	正極長さ（mm）	放電容量維持率 %
本発明電池A	10	50	150	90
比較電池X	1	50	1500	76
比較電池Y	1（タブ10枚）	50	1500	78

[0028]Compared with the comparison cells X and Y, a discharge capacity maintenance rate in high rate of this invention cell A is high so that clearly from a result of Table 1.

High discharge characteristics are good.

Since the heterogeneity of a reaction in each electrode was eased by increase in electrode number of sheets and high discharge capacity increased by it, this is considered.

[0029]** The experiment 2 experiment 2 examined the optimal range about a size

of an electrode adopted as a secondary battery of this invention. this invention cell B0 as well as this invention cell A was produced except using a positive electrode 250 mm in length. this invention cell B1 as well as this invention cell A was produced except using a positive electrode 200 mm in length. This invention cell B-2 was produced like this invention cell A except using a positive electrode 50 mm in length. this invention cell B3 as well as this invention cell A was produced except using a positive electrode 25 mm in length. this invention cell B4 as well as this invention cell A was produced except using a positive electrode 5 mm in length. This invention cell B5 was produced like this invention cell A except using a positive electrode 3 mm in length. This invention cell B6 was produced like this invention cell A except using a positive electrode 150 mm in width, and 650 mm in length. this invention cell B7 was produced like this invention cell B6 except using a positive electrode 600 mm in length. this invention cell B8 was produced like this invention cell B6 except using a positive electrode 250 mm in length. this invention cell B9 was produced like this invention cell B6 except using a positive electrode 100 mm in length. this invention cell B10 was produced like this invention cell B6 except using a positive electrode 50 mm in length. this invention cell B11 was produced like this invention cell B6 except using a positive electrode 15 mm in length. this invention cell B12 was produced like this invention cell B6 except using a positive electrode 12 mm in length. A measurement result about these this invention cells B0-B12, and A is shown in Table 2.

[0030]

[Table 2]

	正極幅W (mm)	正極長さL (mm)	W/L (-)	放電容量維持率 %
本発明電池B0	50	250	0.20	82
本発明電池B1	50	200	0.25	85
本発明電池A	50	150	0.33	90
本発明電池B2	50	50	1.00	90
本発明電池B3	50	25	2.00	87
本発明電池B4	50	5	10.00	85
本発明電池B5	50	3	16.67	83
本発明電池B6	150	650	0.23	83
本発明電池B7	150	600	0.25	85
本発明電池B8	150	250	0.60	90
本発明電池B9	150	100	1.50	88
本発明電池B10	150	50	3.00	86
本発明電池B11	150	15	10.00	85
本発明電池B12	150	12	12.50	82

（正極枚数：10枚）

[0031]The discharge maintenance rate of the width W of a positive electrode and the length L which it is in high discharge is high comparatively (W/L) especially in 0.25-10 irrespective of the width (50 mm/150 mm) of a positive electrode so that clearly from the result of Table 2. Therefore, the width W of a positive electrode and the thing of length L set comparatively (W/L) as the range of 0.25-10 are preferred.

[0032]** The experiment 3 experiment 3 examined the optimal range about the rate of the full length L of a positive electrode, and the length of a non-coating part. this invention cell C0 as well as this invention cell A was produced except using the positive electrode whose length of a non-coating part is 1 mm. this invention cell C1 as well as this invention cell A was produced except using the positive electrode whose length of a non-coating part is 3 mm. this invention cell C2 as well as this invention cell A was produced except using the positive electrode whose length of a non-coating part is 7 mm. this invention cell C3 as well as this invention cell A was produced except using the positive electrode whose length of a non-coating part is 15 mm. The measurement result about these this invention cells C0-C3, and A is shown in Table 3.

[0033]

[Table 3]

	正極長さ L (mm)	未塗工部の長さ (mm)	割合＊ (%)	放電容量維持率 %
本発明電池C0	150	1	0.7	82
本発明電池C1	150	3	2.0	85
本発明電池A	150	5	3.3	90
本発明電池C2	150	7	4.7	90
本発明電池C3	150	15	10.0	90

(正極枚数：10枚)
(正極幅：50mm)

[0034]The discharge capacity maintenance rate with a rate of the length of the non-coating part to the full length of a positive electrode high at not less than 2.0% was obtained, and change was lost at not less than 3.3% so that clearly from the result of Table 3. Therefore, it can be said that not less than 2.0% of the rate of the length of the non-coating part to the full length of a positive electrode is desirable.

[0035]** The experiment 4 experiment 4 examined the optimal range about the number of sheets of the positive electrode which constitutes a secondary battery. this invention cell D0 as well as this invention cell A was produced except using the positive electrode of two sheets. this invention cell D1 as well as this invention cell A was produced except using the positive electrode of three sheets. this invention cell D2 as well as this invention cell A was produced except using the positive electrode of five sheets. this invention cell D3 as well as this invention cell A was produced except using the positive electrode of 15 sheets. this invention cell D4 as well as this invention cell A was produced except using the positive electrode of 20 sheets. this invention cell D5 as well as this invention cell A was produced except using the positive electrode of 30 sheets. this invention cell D6 as well as this invention cell A was produced except using the positive electrode of 35 sheets. The measurement result about these this invention cells D0-D6, and A is shown in Table 4.

[0036]

[Table 4]

	正極枚数（枚）	放電容量維持率 %
比較電池	1	78
本発明電池D0	2	81
本発明電池D1	3	85
本発明電池D2	5	88
本発明電池A	10	90
本発明電池D3	15	90
本発明電池D4	20	88
本発明電池D5	30	85
本発明電池D6	35	83

（正極幅50m
長さ：150mm）

[0037]The high discharge capacity maintenance rate is high in the range in which especially 3-30 positive electrode number of sheets is, and 3-30 sheets can call positive electrode number of sheets the optimal range so that clearly from the result of Table 4.

[0038]Various modification is possible for each part composition of this invention in technical scope given not only in the above-mentioned embodiment but Claims. For example, this invention can be carried out not only to a lithium secondary battery but to various nonaqueous electrolyte secondary batteries.

[Translation done.]